The Profitability of Ante Bellum Agriculture in the Cotton Belt: Some New Evidence

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Perhaps no subject in American economic history has undergone more intensive scholarly scrutiny in the past 15 years than the question of the viability of ante bellum southern agriculture, with particular emphasis on the profitability of slavery. Why raise this question again?

First, we think that a number of interesting issues have been neglected in the studies evaluating the profitability of slavery, such as the profitability of capital and the question of returns to scale.

Second, this paper represents a measurement of slave profitability which derives the estimated output per slave from a production function, rather than the methods used by Conrad and Meyer, et al. We offer findings that are basically consistent with most of the recent quantitative studies on slavery, but some of our results might be interpreted as supportive of the conclusions of Phillips, Ramsdell, and Genovese [15, 17, 10].

The major features of agriculture in the primary cotton producing regions of the ante bellum South have been well described elsewhere [13, 5, 1, 24]. We do not propose to cover that ground again. There were some 108 counties in the South which produced over 15,000 bales of cotton in 1859. Six of these were also important producers of rice or sugar cane, and another eleven counties had substantial non-slave populations; these seventeen counties were excluded from our analysis for reasons to be made apparent later. The remaining 91 counties constitute the subject of this study and were distributed over ten southern states as follows: Alabama (22), Arkansas (5), Florida (1), Georgia (7), Louisiana (9), Mississippi (26), North Carolina (1), South Carolina (11), Tennessee (5), and Texas (4).[1] These counties produced a majority of the cotton in America in 1849 and 1859, approximately 57 percent and 54 percent respectively.

We classified 22 of our 91 counties as containing predominantly alluvial acreage based on L. C. Gray's classification of major cotton producing counties [11, pp. 61–62]. Although all the alluvial counties in our analysis are in states that were settled comparatively late, in the New South, by no means are all of the non-alluvial counties in the Old South. The mean longitude of the 22 alluvial counties is 90°48′, and the mean longitude of the 69 nonalluvial counties is 87°22′, more than 200 miles further east.

I. A Conceptual Framework

For several decades economists studying the functional relationships between factor inputs and outputs have generally found it more efficient to express the relationships in equation form. While almost an endless number of production functions have been suggested, the Cobb-Douglas production function probably remains the most popular formulation, in large part due to its simplicity but also because it is more compatible with empirical data. In its un-

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[1] Some states with comparatively large cotton crops seem under-represented in our 91 counties, e.g., Georgia, while other states with comparatively small crops seem over-represented, e.g., South Carolina. Experimentation with other groupings (with proportionately more Georgia counties) did not change the results by much.

restricted form, the Cobb-Douglas function may be expressed:

$$Q = AL^{\alpha}K^{\beta} \text{ where } \alpha \geq 0 \text{ and } \beta \geq 0 \quad (1)$$

Q = output
L = labor input
K = capital input
α = the output elasticity of labor input
β = the output elasticity of capital input.

This equation may also be expressed in log form as:

$$\log Q = \log A + \alpha \log L + \beta \log K. \quad (1\text{a})$$

The marginal products of the productive inputs are:

$$\frac{\partial Q}{\partial L} = \alpha \frac{Q}{L} \quad (2)$$

and

$$\frac{\partial Q}{\partial K} = \beta \frac{Q}{K}. \quad (3)$$

In the context of the ante bellum slave economy, we have available estimates of Q, L, and K from the census returns. Since by modern statistical estimation techniques we can estimate a value for α and β, we can estimate the marginal products of the two inputs. Likewise it is possible to calculate the internal rate of return to each factor:

$$\frac{\alpha \frac{Q}{L} - M_L}{P_L}$$

and

$$\frac{\beta \frac{Q}{K} - M_k}{P_k} \quad (4)$$

M_L = the cost of slave maintenance
M_K = the cost of capital maintenance (depreciation)
P_L = the price of labor
P_K = the price of capital.

To illustrate, suppose census statistics suggest that the average productivity of a slave was \$350 in 1859, and we estimate α to equal .40 (meaning a 0.40 percent increase in output is associated with a 1.0 percent increase in the slave input). This suggests a marginal productivity per slave of \$140 (350 × .40). From this, subtract maintenance costs of, say, \$20 per slave. Suppose that the average slave price equals \$1000. The rate of return then is

$$\frac{(.40 \times \$350) - \$20}{\$1000} = \frac{\$120}{\$1000} = 12.0 \text{ percent.}$$

A similar process can be used to calculate the rate of return on the capital input. Assuming profit maximizing behavior, factor mobility, perfect knowledge, and equal expectations concerning capital gain and loss, the rates of return on the two inputs of labor and capital would tend to be equal, i.e.,

$$\frac{\alpha \frac{Q}{L} - M_L}{P_L} = \frac{\beta \frac{Q}{K} - M_k}{P_k}.$$

Failure of the rates of return to be equalized would suggest: (i) southern farm operators did not seek to maximize profits; (ii) knowledge was imperfect, presumably due to the costs of obtaining and applying information on the production function and factor prices; (iii) mobility of factors was impaired by legal or other institutional obstacles; (iv) one of the inputs had uses other than for producing agriculture output, e.g., slaves used for consumption purposes in the case of domestic servants; (v) the factors possessed differential non-pecuniary convenience yields, e.g., slaves may have been more liquid assets than land and machines or slaves may have been more substitutable among production uses than capital inputs; (vi) it is assumed that all observations are equilibrium ones. This is necessary for the regressions used here, but disequilibrium could explain different rates of return; (vii) expectations as to future earnings varied between inputs.

This last point deserves brief elaboration. Yasukichi Yasuba [25] has shown that merely demonstrating that rates of return on slavery were high relative to alternative investments is not a sufficient condition for demonstrating profitability.[2] The true measure of the profitability of an investment is the discounted present value of expected future net earnings, and if that value exceeds the market price of the input, the investment is considered profitable. Any discussion of the profitability of factor inputs in southern agriculture should take into consideration the expectations question, and we intend to return to it later.

In respect to the Cobb-Douglas production function estimation approach, we feel that it has several advantages over other approaches to the question of slave profitability. It permits direct estimates of rates of return on alternative inputs, i.e., we make a separate calculation of the return to slaves and to other forms of capital. Previous studies (e.g., Conrad and Meyer) have generally assumed that the returns to the factors of production were equal, but it would seem that other non-slave factors of production in corn and cotton output, such as land and machines, were the most obvious alternative investment to buying more slaves.[3]

If one can show that the rate of return on capital in southern cotton farming was higher than the rate of return on slaves, one might conclude that the typical farmer was relatively over-invested in slaves compared to capital. For this to be the case, however, it would be necessary to show that the differential yield on capital and slaves was not explained by the possibilities mentioned above. We take this up again later in the paper. This approach also permits the researcher to estimate whether slavery was exhibiting constant, decreasing, or increasing returns to scale—an issue that is talked about but not explored rigorously in most of the recent literature [14, pp. 324–25; 6, pp. 364–65; 8, p. 46].[4]

II. Data and Estimation Techniques

Consider the data employed and our estimation techniques. We propose to use a log-linear ordinary least squares regression technique to estimate directly the α and β coefficients for the simple two variable input Cobb-Douglas model (equation 1). We shall try to explain variations in the average output per farm for the 91 leading cotton producing counties by means of variations in the inputs of labor and capital among counties. While it is recognized that ante bellum southern agriculture was too complex to be fully represented by any model with only three variables, we do believe that if such a simple model can explain a majority of variation in output it will provide a useful approach to the investigation of agriculture in the cotton belt.

The dependent variable is the average value of cotton and corn output per farm by county. We summed the total county cotton and corn production, priced it, and divided this by the number of farms in the county. In the case of cotton, we used a price of $37.40 per bale in 1849 and $44.00 per bale in 1859. The corn prices were 51 cents per bushel in

[2] Yasuba's main point was that the "discounted present value at the market rate" be equal to, or above, the cost of producing slaves. The latter might differ from the market price, so that profitability need not imply viability.

[3] A usual practice has been to calculate the rate of return in slave-owning and then to compare this rate of return with available security yields such as railroad bonds.

[4] We discuss the question of economies of scale throughout the article. An excellent discussion of the use of unrestricted Cobb-Douglas production functions to measure economies of scale may be found in [4]. Ferguson defends the use of the unrestricted Cobb-Douglas function for this purpose (particularly when cross-section data are employed) but is careful to point out that this involves an assumption that the elasticity of substitution between the factors is unitary.

1849 and 77 cents per bushel in 1859.[5] Although we believe these prices are defensible, some rates of return using lower prices will also be reported.

The measure of production excludes the output of other farm products, such as wheat, oats, beans, peas, fruit, potatoes, household manufactures, etc. Meat production is included to the extent that corn is converted into meat. We do not believe that these omissions seriously impair the validity of our analysis. One reason for excluding the minor crops was that we lacked complete price or output data. The problem of excluded output is ameliorated by the fact that we have confined our analysis to those counties which were large cotton producing counties. Also the excluded output does not affect the estimates of the production elasticity coefficients (α and β), except to the extent that the proportion of total output that is excluded varied from county to county. The excluded output is taken into account in calculating the internal rate of return on slave investment, a point to which we will return.

The amount of "capital per farm" for each county was obtained by summing the values of the following census categories and then dividing by the number of farms in the county: cash value of farms, farm implements and machinery, horses, mules and asses, and oxen. The category "cash value of farms" includes the value of the land and improvements on the land, such as buildings and fences. It is a measure of both the quantity and the quality of the land, at least to the extent that quality is reflected in land prices. The category "farm implements and machinery" consists of the dollar value of the capital equipment as stated in the census returns. The draft animals are given in the census in physical units and not in value terms as are the previous two categories comprising our capital variable. We deflated Department of Agriculture [21, pp. 36–37] prices of horses and mules for Mississippi in 1870 by the Towne and Rasmussen [20, p. 266] index of livestock prices to arrive at horse and mule prices for 1849 and 1859. The oxen price is more tenuous and was obtained from a survey of newspapers of the period.[6]

The question arises as to why we did not separate the land and capital inputs and estimate a production function with three variable inputs: land, labor, and capital. This would obviously provide more information than our two variable input model consisting of land and capital where the latter variable includes land as well as machinery and animals. It is difficult to distinguish between land and capital from the census returns. The "cash value of farms" category includes both the value of land and the improvements affixed to it, the latter being barns, sheds, fences, drainage, etc. Although an alternative measure of land alone does exist, the number of improved acres per farm, it provides no adjustment for variation in soil quality or the availability of transportation among counties. A more important objection to the three variable input model is that substantial multicollinearity occurs when land and capital inputs are entered as separate variables. Thus the independent variable called capital is an inclusive one, consisting of land, buildings, machinery, and work animals although undoubtedly the value of land bears the heaviest weight.

To measure the other independent variable, labor, we used the number of rural

[5] The cotton production by county given in the census returns is in bales labeled 400 pounds each, but there is some question as to the actual weight of these bales across time and space. We use the 400 pound estimate and price cotton at 9.35 cents per pound in 1849 and 11 cents per pound in 1859. These are three-year averages centered on 1849 and 1859 taken from Conrad and Meyer [3, p. 76]. The corn price is also a three-year average price taken from Cole [2].

[6] The 1849 prices used were: horses, $57; mules and asses, $73; oxen, $39. The 1859 prices used were: horses, $73; mules and asses, $93; oxen, $50.

slaves per county. Three problems arose in quantifying the labor input. First, it was recognized that the assumption that all labor was attributable to slave labor was tenuous. Accordingly, the analysis is restricted to the largest cotton producing counties, as previous writings have suggested that the vast majority of output in these areas was produced on farms by slave labor. Also, as pointed out above, we excluded eleven large cotton producing counties where the slave population comprised a relatively small proportion of the rural population (less than 40 percent), suggesting that much of the cotton and corn output was in fact produced bv non-slave labor.

The 91 counties remaining in the analysis all had substantial rural slave populations and substantial cotton output. While some non-slave labor input is undoubtedly being picked up by our labor variable, we believe we have minimized the problem. In any case, the existence of non-slave labor input does not impair the validity of the rates of returns based on our estimates of α and β, except to the extent that the *proportion* of non-slave labor input varied among counties. If the proportion of the labor force that was non-slave was the same in every county, the exclusion of that labor would merely affect the statistical estimation of the constant term in the regression equation, a term which is relatively unimportant to the analysis.

Because of a lack of satisfactory data on non-slave labor input, any arbitrary addition of some non-slave input to each of our 91 county observations would certainly impair the character of the analysis. Moreover, mixing slave and non-slave labor inputs into a single variable would make it difficult to reach unambiguous statements concerning the profitability of slavery. Consequently, we prefer to proceed by excluding non-slave labor input, conceding that inter-county variations in that input might affect our results although we do not think seriously. Consideration of some aspects of non-slave labor inputs, such as supervision costs (e.g., overseer wages), will be taken up later.

A second problem with estimating the labor input is that the proportion of the slave population engaged in agricultural pursuits varied among counties. Fortunately, the 1850 and 1860 censuses give information on the number of slaves living in towns. These slaves presumably were mainly engaged in non-agricultural pursuits and were accordingly subtracted from the county statistics of the number of slaves.

The third problem with estimating labor input concerns variations in the rate of labor force participation among the rural slave population in the 91 counties under investigation. Unlike most other approaches to the slavery profitability question, the *average* rate of labor force participation is relatively unimportant in our analysis. Whether that rate is 40 percent, 50 percent, or 60 percent, is of no consequence in the determination of the estimates of output elasticities (α and β); the average participation rate affects only the constant term. Only inter-county *variations* in the participation rate affect the estimates of the partial elasticity of staple output with respect to inputs.

If the proportion of the rural slave population involved in the production of the major staple crops varied substantially among counties, the use of the number of rural slaves (or a fixed proportion of that number) as a proxy for the labor force would be unsatisfactory. While no specific data on slave labor force participation in staple production exists for these counties, we did adjust for inter-county differentials in the age composition of the labor force by using the proportion of the total male slave population between the age of 15 and 59. Manifestly, a number of thorny problems exist in estimating the labor input in the ante bellum cotton belt. We believe that the steps that we

have taken have reduced these problems to manageable proportions, conceding all the while that some imperfections still exist.

III. Empirical Results

We are now ready to proceed to the statistical estimation of Cobb-Douglas type production functions for 91 cotton belt counties for 1849 and 1859. Applying ordinary least squares linear regression analysis to the data described above, we estimated equation (1a). As that equation suggests, a direct estimation of the Cobb-Douglas production function requires a log-linear regression model. Also, scatter diagrams indicate that the log-linear form provides a better fit of the data than a pure linear model.

The basic results obtained are:

$$\log Q_{1849} = -0.12 + \underset{(0.12)}{0.46} \log L + \underset{(0.11)}{0.43} \log K, \quad R^2 = .79 \qquad (7)$$

and

$$\log Q_{1859} = -0.53 + \underset{(0.11)}{0.46} \log L + \underset{(0.09)}{0.55} \log K, \quad R^2 = .81 \qquad (8)$$

where Q is the average dollar value of cotton and corn output per farm in the 91 county region, L is the average input of slave labor per farm, and K is the average input of land and capital per farm. The numbers in parentheses are standard errors of the coefficients.

The results are gratifying. The model explains approximately four-fifths of the total variation in output per farm between the 91 counties in both years. Both the α (slave labor) and β (land and capital coefficient) are significantly positive at the 1 percent level. The output elasticity of the labor input changed very little from 1849 to 1859, approximately 46 in both years, while the output elasticity of the land-capital input increased substantially, from .43 to .55.

Do the estimates suggest the existence of increasing, constant or decreasing returns to scale? The sum of the α and β coefficients for 1849 is .89 while for 1859 it is 1.01. In other words, a 1 percent increase in the use of both inputs would have been associated with a 0.89 percent increase in output in 1849, and a 1.01 percent increase in output in 1859. The results suggest some decreasing returns to scale in 1849 and near constant returns in 1859. The results suggest that returns to scale were roughly constant in the late ante bellum period—a finding generally consistent with many empirical estimates of Cobb-Douglas production functions for different outputs, places, and periods [23]. It is also consistent with some of the literature on agriculture in the ante bellum South. Ulrich B. Phillips, for example, once stated [16, p. 128]:

> "Cotton was adapted to cultivation on any scale, great or small, with no peculiar disadvantage in any case. . . . One-horse farmers and 100 slave planters competed on fairly even terms."

Our findings, however, seem to be at variance with those of Robert Fogel and Stanley Engerman. In *Time on the Cross,* they state "there were economies of scale in southern agriculture" and "economies of scale were achieved only with slave labor." [7, pp. 193–94]. It may well be, however, that the observed near constant returns to scale disguises differences existing between the alluvial and the non-alluvial areas, a subject which will be examined later. Wright found evidence of decreasing returns in the non-alluvial but not in the alluvial lands [24, ch. 4].

IV. Rates of Return on Factors of Production

It is comparatively easy to calculate rates of returns based on the estimates of the elasticities of output with respect to changes in each of the inputs (the α and β

coefficients). Nonetheless, any estimation of rates of return implicitly must be based on certain assumptions about the prices of output, the cost of slave and capital inputs, slave maintenance costs, and the rate of depreciation or appreciation of the stock of labor, land, and capital. Because scholars are not in uniform agreement on these matters, we will first present rates of return based on what we think are reasonable assumptions but then offer a range of returns incorporating alternative assumptions.

The first assumption concerns allocating output not explained by the two variable inputs. We have simply apportioned this output to the two inputs in proportion to the size of their estimated output elasticities. Symbolically it was assumed:

$$Q_L = Q_F \frac{\alpha}{\alpha + \beta} \tag{9}$$

and

$$Q_K = Q_F \frac{\beta}{\alpha + \beta} \tag{10}$$

where Q_L is cotton and corn output that can be attributed to slave labor, Q_F is the average output per farm in the 91 counties, α is the estimate of the output elasticity of the slave labor input, β the estimate of the output elasticity of the land-capital input, and Q_K is the output that can be attributed to the land-capital input. The importance of this apportionment assumption varies directly with the extent to which the summed estimates of α and β deviate from 1.0 (constant returns to scale). Fortunately, in the case of the estimates presented above, the deivation from 1.0 is not substantial.

A second assumption discussed earlier pertains to the prices used to estimate the value of cotton and corn production. To repeat, we will initially assume the following prices were obtained by farmers: cotton, 9.35 cents per pound in 1850 and 11.0 cents in 1860; corn, 51 cents per bushel in 1849 and 77 cents in 1859.

A third matter requiring resolution before offering rates of return pertains to the average capital cost of the labor input. For 1849 we settled on an average value per slave of $600; for 1859 we assumed $1000. Shortly these prices will be varied. Without going into detail, we feel these prices are near the middle of the range of estimates of average slave prices suggested by other scholars [11, pp. 665–66; 15, p. 267; 3, pp. 51, 87–92; 19, pp. 368, 375].

What about slave maintenance costs? We have seen estimates of average maintenance costs ranging from $15 to $45, with most estimates falling in the $20 to $35 range. A figure of $25 or $30 might seem appropriate. Recall that our output estimates exclude all production of vegetable products, grains other than corn, orchard products, etc., and it excludes part of the meat output. It seems reasonable to assume that this excluded output accounted for the major costs of feeding slaves. Taking this into account, we use a maintenance cost estimate per slave of $15. Alternative maintenance costs will be used later. It should be pointed out that the $15 maintenance cost includes costs associated with supervising slaves.[7] To that extent we are taking non-slave labor inputs into account in calculating rates of return.

The estimates of the capitalized value of the land-capital input are largely derived from the values given by farm operators to census enumerators in 1850 and 1860. It is assumed that these estimates reflect with reasonable accuracy market values of land, and improvements made to the land (e.g., farm buildings). We will later vary that assumption.

In regard to rates of depreciation on the land-capital input, we decided to use 4 percent per annum—implying that land and capital wore out over 25 years (using

[7] Supervisory costs were estimated by Saraydar at $10 per field hand [18]. Our $15 maintenance costs per slave includes $5 of supervisory costs.

straight-line depreciation). This seems reasonably consistent with some accounts suggesting that land had an average life of 30 years, and implements and machinery 15 (land, being quantitatively more important, should be weighed more heavily than implements and machinery). Alternative rates will be suggested later.

Concerning draft animals, we assume zero maintenance costs—that they lived primarily off grass, corn fodder, and other items not counted in the output side of the equation. We assume that draft animals reproduced in sufficient numbers to maintain a constant stock.

In regard to slaves, census population sources suggest that the slave population was increasing about 2.15 percent per year in the South. We will assume that this breeding factor led to an annual increase in the capitalized value of slaves by that amount. Rates of return with and also without this capital appreciation factor incorporated will be presented.

The rate of return estimates for the 91 county region for 1849 and 1859 are shown in Table 1. Ante bellum cotton agriculture appeared to be quite profitable with a rate of return on combined inputs approximating 8 percent in both 1849 and 1859, not counting the capital appreciation associated with the increase in slave population; taking this factor into account raises the rate of return to nearly 10 percent in both years. Both the high rates of return and the slight increase observed from 1849 to 1859 suggest that southern cotton agriculture was a highly profitable business on the eve of the Civil War. This finding is consistent with most other quantitative studies on the subject, including the recent one by Fogel and Engerman [7].

A much less conventional finding of this study is that the estimated rates of return on slaves are well below the estimated rates of return on agricultural land and capital for both 1849 and 1859. This is very interesting considering that most previous studies on slave profitability have proceeded from the implicit assumption that the rates of return on land-capital equaled the return on slaves. It further suggests that perhaps slaveowners *were* overinvested in slaves since greater returns were realizable on the most obvious alternative investment—agricultural land and capital. While the results are consistent with the conclusion of Conrad and Meyer and others that the rate of return on slaves was at least equal to that obtainable in high grade securities, we would ask whether that is the relevant comparison. Even though the slavery rates of return are as high as Conrad and Meyer's, our initial conclusion is closer to the "slave overcapitalization" argument of Phillips and Ramsdell.

If the 13 percent rates of return reported are accurate for land and capital investment and if the 8 percent rates of return are correct for slave investment, then perhaps excessive demand for slaves did force slave prices up to the point where the rates of return on slaves were relatively low. Some possible explanations for such an existing differential have already been mentioned; we consider this an important finding and plan to return to this again later in the paper.

V. Alternative Estimates of Rates of Return

Underlying assumptions have been made concerning the value of output, maintenance and depreciation costs on inputs, and the value of inputs. Will changes in these assumptions alter our basic conclusion that ante bellum agriculture was profitable in the cotton belt but that planters may well have been overinvested in slaves? In Table 2 we re-estimated rates of return using a variety of different assumptions. The range of rates of return on slave investment, adding in a 2.15 percent "breeding factor," was from 4.7 to 9.8 percent in 1849, and from 5.7 to 10.2 percent for 1859. The range of rates of return on

TABLE 1

RATES OF RETURNS ON INPUTS, 1849 AND 1859[a]

Variable Measured	1849	1859
Output[b]	$1,173.48	$2,649.51
Output attributable to slave labor[b]	$606.81	$1,197.58
Slave maintenance costs[b]	$189.33	$241.50
Net operating revenue from slaves[b]	$417.48	$956.08
Value of slaves[b]	$7,572.00	$16,100.00
RATE OF RETURN ON SLAVES, FROM PRODUCTION	5.51%	5.94%
RATE OF RETURN ON SLAVES, INCLUDING CAPITAL APPRECIATION FROM BREEDING	7.66%	8.09%
Output attributable to land, capital[b]	$566.67	$1,451.93
Depreciation costs on land, capital[b]	$130.02	$339.77
Net operating revenue, land and capital[b]	$436.65	$1,112.16
Value of land and capital[b]	$3,250.59	$8,494.26
RATE OF RETURN ON LAND AND CAPITAL	13.43%	13.09%
RATE OF RETURN ON BOTH INPUTS, EXCLUDING SLAVE CAPITAL APPRECIATION	7.89%	8.41%
RATE OF RETURN ON BOTH INPUTS, INCLUDING SLAVE CAPITAL APPRECIATION	9.40%	9.82%

[a]Major assumptions employed include apportioning total output using the α and β coefficients; maintenance costs per slave are $15 per year; slaves are valued at $600 in 1849 and $1000 in 1859; the breeding return from slaves equals 2.15 percent for both 1849 and 1859; and land and capital depreciates at a rate of 4 percent per annum.

[b]Per farm basis.

Sources: Calculated from the Seventh and Eighth U. S. Census.

land and capital investments with the same varying assumptions was from 8.2 to 13.4 percent in 1849, and from 7.5 to 13.1 percent in 1859. While the range of returns was generally higher on the land-capital input that on the slave input, the upper range of estimates of slave rates of return was as high or even higher than the lower range of estimates for land and capital—suggesting that near equality of rates of return between factors may have existed.

Under one set of assumptions listed in

TABLE 2

ALTERNATIVE RATES OF RETURN, 1849 AND 1859[a]

Number	Assumption Change	Slave Input	Land-Capital Input
	1850	Percent	Percent
1	Reduce Output by 10 percent (lower cotton, corn prices)	6.86	11.99
2	Increase slave prices 20 percent	6.74	13.43
3	Decrease slave prices 20 percent	9.04	13.43
4	Maintenance cost/slave = $10	8.50	13.43
5	Maintenance cost/slave = $25	6.00	13.43
6	Capital depreciation - 6 percent per year	7.66	11.43
7	Increase land and capital values by 25 percent	7.66	10.74
8	#1,2,5 above	4.69	11.99
9	#3 and 4 above	9.77	13.43
10	#1,6,7 above	6.86	7.99
11	#1,3,4,6,7 above	9.23	7.99
12	None (initial assumptions)	7.66	13.43
	1860	Percent	Percent
1	Reduce Output by 10 percent	7.34	11.38
2	Increase slave prices 20 percent	7.10	13.09
3	Decrease slave prices 20 percent	9.57	13.09
4	Maintenance cost/slave = $10	8.59	13.09
5	Maintenance cost/slave = $25	7.08	13.09
6	Capital depreciation - 6 percent per year	8.09	11.09
7	Increase land and capital values by 25 percent	8.09	10.47
8	#1,2,5 above	5.65	11.38
9	#3 and 4 above	10.20	13.09
10	#1,6,7 above	7.34	7.50
11	#1,3,4,6,7 above	9.27	7.50
12	None (initial assumptions)	8.09	13.09

[a]All slave returns are increased 2.15 percent for capital appreciation from growth in slave population.

Source: See text for computation methods.

Table 2, number 11, the rates of return on slaves are actually higher than the rates of return on land and capital. The assumptions that give higher rates of return on slaves than on land-capital include: reduce the prices of staple crops 10 percent from our initial assumptions (e.g., the price of cotton from 11 to 9.9 cents per pound in 1859); decrease the average slave prices used in our calculations by 20 percent (to $480 in 1849 and $800 in 1859); assume the maintenance cost per slave is only $10; assume land and capital depreciates 6 percent per year (is completely "used up" in 16.7 years using straight-line depreciation), and assume that land and capital values were understated in the census by 25 percent in each county.

In our judgment, each of these individual assumptions is plausible. The probability that *all* of these assumptions are accurate is, however, almost nil in our opinion. For example, we think $800 is an unrealistically low average slave price for 1859, and that $10 is an unrealistically low maintenance cost for slaves. Dropping these two assumptions, but still retaining the other three assumptions (higher capital depreciation, higher land and capital values, and lower staple prices), we obtain higher rates of return on land-capital than on slaves although the differential is very small by 1859 (see assumption number 10, Table 2).

Starting with the alternative assumptions suggested in Table 2, there are 42 possible combinations of assumptions, all yielding different rates of return. Of these, 38 yield higher returns on land and capital than on slaves. *All* the exceptions assume that slave prices were lower in 1860 than our original assumption ($800 *vs.* $1000), that land and capital depreciation was more rapid (6 *vs.* 4 percent per year) and that land and capital values were understated in the 1850 and 1860 Censuses.

We readily admit that some of the initial assumptions may have been inaccurate in some manner. Accordingly, we have presented a "menu" of alternative assumptions, and only in 10 percent of them is the rate of return on slaves as high as it is on land and capital. The four sets of assumptions that yield higher returns on slaves combine, in our opinion, a number of highly tenuous judgments about input and output prices, maintenance, and depreciation costs. Accordingly, we prefer to abide by our original statement that the evidence suggests that returns were higher on land and capital than on slaves in 91 leading cotton producing counties in the late ante bellum South.

VI. Alluvial and Non-Alluvial Estimates

All of the above conclusions pertain to the entire 91 major cotton producing counties. Most of the previous literature would suggest, however, that rates of return on factors varied among counties with alluvial and non-alluvial soils. Lands with alluvial soils, it has been argued, yielded higher returns on slaves than the non-alluvial soil areas [3, p. 61; 8, pp. 53–55; 11, p. 912; 19, p. 376; 18, p. 331]. Accordingly, we re-estimated the elasticities of output with respect to changes in inputs (α and β) for the 69 non-alluvial counties and also for the 22 alluvial counties in our sample. Using the same underlying assumptions as before (Table 1), we then calculated the rates of return which are presented in Table 3.

The results are interesting. The Cobb-Douglas model again performs well, explaining much of output variation in every case and more than 90 percent in the case of the alluvial counties both in 1849 and 1859. The α and β coefficients are highly significant in a statistical sense in all cases. The results reveal substantial differences between the alluvial and non-alluvial areas, as well as substantial changes over time. The major findings are enumerated below:

1. The returns to scale were much greater in the alluvial areas than in the non-alluvial

TABLE 3

RETURNS ON INPUTS, ALLUVIAL AND NON-ALLUVIAL AREAS, 1849-1859[a]

Variable Measured	Alluvial	Non-Alluvial
1850		
Output elasticity of labor (α)[b]	.44	.46
Output elasticity, land-capital (β)[b]	.51	.33
α and β (returns to scale measure)	.94	.80
R^2 (coefficient of determination)	.91	.57
Rate of return on slaves from production	4.62%	6.55%
Rate of return on slaves, including capital appreciation from breeding	6.77%	8.70%
Rate of return on land-capital	14.44%	11.28%
Rate of return on both inputs, excluding any slave capital appreciation from breeding	7.62%	7.96%
Rate of return on both inputs, including slave capital appreciation from breeding	9.47%	9.11%
1860		
Output elasticity of labor (α)[b]	.54	.45
Output elasticity, land-capital (β)[b]	.60	.45
α and β (returns to scale measure)	1.15	.90
R^2 (coefficient of determination)	.94	.65
Rate of return on slaves from production	8.17%	6.06%
Rate of return on slaves, including capital appreciation from breeding	10.32%	8.21%
Rate of return on land-capital	11.99%	11.90%
Rate of return on both inputs, excluding any slave capital appreciation from breeding	9.71%	7.96%
Rate of return on both inputs, including slave capital appreciation from breeding	10.99%	9.41%

[a]Assumptions used to calculate rates of return are same as in Table 1.
[b]All α and β estimates are significant at the two percent level.
Source: See text.

areas. Increasing returns to scale were exhibited in alluvial areas by 1860 while slight decreasing returns to scale still existed in non-alluvial areas.

2. In both alluvial and non-alluvial areas, there was a tendency for larger scale operations to become economically more advantageous (or less disadvantageous) over time—the sum of the α and β coefficients was greater in 1859 than in 1849.

3. The overall rates of return on agricultural output (both inputs) were high in both areas compared with other investments—9 to 11 percent. The rate of return on farming was about the same in the alluvial as in the non-alluvial areas in 1849, although a rising return in the alluvial areas created some differential by 1859.

4. The rates of return on land and capital were higher than the return on slaves in both areas for both dates.

5. In 1849 the rates of return on land and capital were greater in the alluvial than in the non-alluvial areas, but a fall in the rate of return in the alluvial areas and an increase in the non-alluvial areas virtually eliminated the differential by 1859.

6. In 1849 returns on slaves were greater in the non-alluvial areas than in the alluvial areas, but by 1859 the reverse was the case. The differential in both cases was not substantial, about 2 percent.

7. The differential rates of return on the two factors narrowed in the alluvial areas in the 1850's but actually widened somewhat in the non-alluvial areas.

The fairly distinct differences observed between the alluvial and non-alluvial areas with respect to returns to scale, output elasticities of inputs, factor rates of return, and relative factor proportions suggest that possibly substantial differences existed in the scope and method of farm operations between the alluvial and non-alluvial areas. Speculation as to the nature, extent, and causes of these differences is beyond the range of this paper, but further study should prove profitable.

The observation that rates of return on slaves in the non-alluvial areas was actually higher than in the alluvial areas in 1849 (and not too much lower in 1859) is a conclusion that differs somewhat from that reached in other recent studies of the subject.[8] Equally controversial, the high rates of return on land and capital in both the alluvial and non-alluvial areas reaffirms our suspicion that most previous quantitative studies of slavery either committed errors of omission or commission in their treatment of investment in land and capital. The general conclusion that cotton belt agriculture was exhibiting high rates of return on the eve of the Civil War is generally in accord with the views of modern scholars.

VII. A Differential Expectations Hypothesis

Why are the estimates of the rates of return on land and capital so high (about 13 percent) compared with the estimated rates of return on slaves (about 8 percent)? Seven possible explanations were suggested earlier. Not all of these explanations readily lend themselves to empirical examination, e.g., the notion that slaveowners were prestige maximizers. In any case, an elaborate investigation of the reasons for the difference is beyond the scope of the paper. Yet there is some empirical evidence that is consistent with the notion that slaveowner expectations of capital gains were greater for the labor input than for the land and capital input, and that this explains most of the observed differential in rates of return. Less important, there is some evidence pertaining to the use of slaves for consumption purposes, e.g., as domestic servants.

Turning to the second point first, Gallman and Weiss' work on the service industries

[8] As the same prices were used in both regions, this result seems even more at odds with the other studies.

suggests that a maximum of 25 percent of the working slave population was in domestic service in rural areas [9, p. 360]. Making the rather extreme assumption that the marginal productivity of these domestic servants was the same as that of field hands, we recalculated the rate of return on slaves from production in 1859. Our estimate of the rate of return on slaves from production increased from about 5.9 percent to 8.4 percent, or from 8.1 percent to 10.6 percent if one considers the increase in slave population. This is almost precisely one-half the estimated differential (using our initial set of assumptions) in the rates of return between slaves and land-capital. It is probably more realistic, however, to assume that the marginal productivity of domestic workers was lower than that of field hands.

As Fogel and Engerman point out, "servants were generally youngsters under 15 or persons in the late 40's, 50's, 60's, and 70's." [7, p. 220]. Relatively few men in the most productive age groups worked as domestics. If we assume that the marginal productivity of the 25 percent of the slave work force that was engaged in domestic service was one-half that of field hands, our estimated rate of return on slaves from production increases from 5.9 to almost 7.2 percent (counting slave population appreciation, from 8.1 to 9.3 percent). This is about one-quarter of the estimated differential in the rates of return on the two inputs. Therefore, we would conclude that the use of slaves for consumption purposes could account for a small fraction of the observed differential in rates of return.

The differential expectations hypothesis for explaining different rates of return on factor inputs is an intriguing one. Essentially, it maintains that the expectation of capital gains from holding a factor of production will be capitalized in the price of that factor and this, in turn, will affect the calculated rate of return. In effect, it postulates that there are two reasons for acquiring ownership of a productive factor: (1) to use in a process of production; and (2) to have as a source of wealth and wealth accumulation through capital gains. Thus a slaveholder in 1859 can be thought of as holding slaves to produce agricultural output and as a vehicle that will provide him with capital gains.

To the extent that this is true, the price of slaves in 1859 will include the discounted present value of any anticipated capital gains from holding slaves. Of course, the same can be said for the price of the capital component of the production process, particularly the land and animals portion of it. Therefore, if the expected rate of capital gain were the same for both inputs, the rates of return of the factors *relative to one another* would not be affected by correcting the factor prices to take account of anticipated capital gains.

However, if the expected rate of capital gain from holding slaves differed from that received by holding the land-capital factor, the relative rates of return would be affected. Specifically, if slaveholders anticipated a greater appreciation in the value of slaves over time than in the value of land-capital, the price of slaves would be higher in 1859 relative to capital than it would be in the absence of such differential expectations. The end result would be a difference in the observed rates of return on capital and slaves as the higher market price of slaves would produce a lower observed rate of return to this factor.

The question now is whether such differential expectations might exist and, if they do, whether they will explain the differentials in rates of return that we have reported. Observing the experience of the decade 1849–1859 provides evidence that supports the differential expectations of capital gain hypothesis. From the census data we find that output per acre increased by about 40 percent in this decade while output per slave increased by about 80 percent. Assuming a constant

returns to scale production function and optimal factor proportions, this suggests an increase in the value of slaves *as a factor of production* of over 6 percent a year and of land about 3 percent a year. Of course, this assumes optimal factor proportions which do not seem to exist given our evidence of differential rates of return. In fact, for optimal factor proportions to exist in 1859 the price of slaves should have been $454.

However, let us assume that slaves and land-capital were being combined in optimal proportions. Can we now explain the differential between a $1000 price for slaves and a $454 price through the device of capital gains? Some simple calculations show that with a 7–8 percent discount rate the discounted present value over 30 years of a 5 percent a year increase in the value of slaves will be approximately equal to this differential.[9]

But is it reasonable to believe that people actually expected such capital gains? From our observations about increases in the value of slaves in the production process relative to land in the decade 1849–1859 we can see an historical experience of a 3 percent rate of accumulation *relative* to land. An additional 2+ percent is provided by the natural rate of growth in the slave population.[10] Thus the historical experience of the decade immediately preceding the Civil War is consistent with a 5 percent rate of increase in the value of slaves relative to land (the major component of land-capital).

While this is an interesting possibility, we now ask the questions, "Why do these differential capital gains exist?" and "Would it be reasonable to assume that they would continue in the future?"

The answer to the first question flows rather nicely from the economic theory of production. Consider a constant returns to scale production function and a situation in which there is (1) a positive shift in the demand for the product and (2) no change in relative factor prices. The adjustment of the increased commodity demand would simply take the form of a movement along the expansion path of the production function. This is true as long as factor inputs can be increased freely. However, there is a definite constraint on the rate at which the slave input can be expanded, viz., 2.15 percent a year, the growth rate of the slave population. Consequently, if the shift in the demand for the commodities being produced substantially exceeds 2.15 percent, it is likely that factor proportions will be altered in order to increase production by the necessary amount.[11] If this occurs, equilibrium can only be re-established through an increase in the price of slaves relative to the price of capital. This has the effect of producing relative capital gains from the holding of slaves.

During the decade of the 1850's corn and cotton production in our sample of counties increased by over 5.5 percent a year, far in excess of the natural rate of reproduction of slaves. It can be argued that this forced changes in factor proportions which, in turn, increased the value of slaves as a productive factor. The extent of such increases is

[9] The exact discount rate chosen is not critical. Any rate between 5 and 8 percent yields results that are consistent with this conclusion.

[10] Treating the natural rate of growth in the slave population as a capital gain differs somewhat from conventional methods of incorporating it into the calculation of the profitability of southern agriculture. The conventional approach is to simply add 2.15 percent to the estimated rate of return, as we did earlier in the paper.

[11] We rule out the possibility of neutral technological progress being sufficiently great to permit the necessary output expansion without a change in factor proportions. This is supported by the census evidence which shows that average output per improved acre increased by 51.1 percent between 1849 and 1859 while average output per field hand increased by 76.9 percent in the same period. This clearly suggests changing factor proportions which indicates that either (1) technological progress was neutral but insufficient to accommodate the change in demand or (2) technological progress was non-neutral.

measured by the rate of change in the average product of the factors. As already noted these suggest that, relative to land, slave prices rose at a rate of at least 3 percent per year during the 1850's. Thus there is a sound theoretical rationale underlying the differential capital gains hypothesis.

Our second question was whether it was reasonable to expect these capital gains to continue into the future. The answer would clearly seem to be, "Yes!" The whole historical experience of the South suggests this. For example, cotton production alone roughly doubled every 10 years after 1820 and the rate of growth showed no signs of abating in the 1850's [3, p. 76]. A full two generations of southern agriculturists were attuned to a growth rate in agricultural production that greatly exceeded the natural rate of growth in the slave population. We see no reason to suppose that expectations in this respect were altered sharply by 1859. Indeed, Fogel and Engerman's "sanguinity index" suggests slaveowner optimism was rising to a record high in the late 1850's [7, pp. 103–06].

The only possible reason for any change might have been the expectations of a Civil War. However, it is by no means clear that to the extent the South anticipated war with the North they viewed it negatively. Some simply saw it as a means of freeing the South from the restrictions being imposed on it by the North and as opening up new vistas for the expansion of slavery.

VIII. Micro Results

The above findings are based on Cobb-Douglas type production functions statistically estimated by relating variations in the arithmetic mean of farm output for each of the 91 counties to variations in the arithmetic mean of labor and land-capital inputs used in those counties. The reader may be troubled, as we are to some extent, by the possibility that the results are distorted by the use of aggregate data.

Specifically, if the pattern of distribution of output or inputs around the arithmetic means varies from county to county (e.g., output per farm is normally distributed for some counties, but is badly skewed for others), the estimates of the output elasticities (and thus the rates of return) could be biased. Only by using data for individual farms can we be sure that the conclusions reached above were not the result of aggregation bias in the data. Accordingly, using precisely the same procedures as above, we estimated a Cobb-Douglas production function for 471 large Louisiana farms, using Joseph K. Menn's compilation of data from the manuscript returns for the Eighth Census [12, pp. 120–380].

The Menn compilation was limited to plantations with 50 or more slaves. We excluded all farms where there was substantial output of sugar cane or molasses, or where the average output per slave was less than one-half the state average, reasoning that the slaves on those farms might be engaged in a substantial amount of non-agricultural employment. The remaining 471 plantations were all large commercial operations: the average financial investment for the 471 farms was a rather extraordinary $192,220 (almost evenly divided between slaves and land-capital) and average output per farm was $26,788.

The major findings arising from our estimated production function were:

1. More than 62 percent of the variation in output per farm can be explained by variations in the use of slave and land-capital inputs. The elasticity of output with respect to each of the two variable inputs is significant at the 1 percent level.

2. The sum of the α coefficient (.63) and the β coefficient (.34) is .97, suggesting nearly constant returns to scale. This finding is very similar to our findings for the 91 counties for

1860, where the α and β coefficients summed to 1.01. It should be remembered that both with the "macro" and the "micro" data, we confined ourselves to fairly large-scale operations.

3. The rate of return on both inputs from production was 11.18 percent. This is above our estimates for 1860 using the macro data (8.41 percent).

4. The rate of return from production on slaves is estimated at 8.31 percent. If the gain from the natural increase in the slave population is added, the rate of return becomes 10.46 percent. The rate of return on slaves is nearly identical to that estimated for the 22 alluvial counties using macro data.

5. The estimated rate of return on the land-capital input is 14.03 percent, about 1 percent higher than our estimate for the 91 counties using the macro data.

6. Consequently, we again observe a substantial differential in the rates of return on the two inputs. The differential, excluding the breeding return from slaves, is nearly 6 percent (about 14 percent on land and capital, and 8 percent on slaves). With the macro data, the differential is about 7 percent (13 percent on land and capital, 6 percent on slaves).

The similarity between the Louisiana results using micro data and the 91-county results using macro data increases our confidence in our earlier results. We are doubtful that any substantial bias is introduced by using the aggregate (macro) data.[12]

IX. Conclusions

What can we finally conclude from the analysis? One rather striking conclusion seems to emerge: ante bellum southern agriculture was immensely profitable with rates of return on investment in excess of 10 percent per annum.

Beyond that, if our differential expectations argument is accepted, it would seem to follow that: (1) since the market price of slaves exceeded their value in the production process, the rate of return on investment *specific to agriculture* was in excess of 13 percent per annum;[13] (2) previous studies of slavery have underestimated the profitability of southern agriculture by including in the price of slaves the discounted present value of expected capital gains from holding slaves; (3) the evidence is consistent with optimizing behavior by southern slaveholders, i.e., it suggests that factor proportions in agriculture were adjusted in a maximizing fashion and that the possibility of capital gains as the results of holding slaves was fully incorporated into slave prices; and (4) about one-half the price of a slave in 1859 reflected his current value as a productive agent, and the other half was the result of anticipation of capital gains.

Collectively, these findings argue very strongly that any notion that slavery was a dying institution economically on the eve of the Civil War is misplaced. That is not a new conclusion. However, what is novel about our version of it is the vigor of the "peculiar institution" at this time. Interestingly, it can be argued that the practice of holding slaves was as lucrative as it was precisely because of the limitations placed on the importation of additional slaves. One of the major effects of this was to limit the rate of expansion of the slave input in southern agriculture to the

[12] Using micro data from the Parker-Gallman sample of farms, Richard Vedder and David Stockdale observed higher rates of return on land and capital than on slaves although the differential was smaller than reported here [22].

[13] To the extent that expected capital gains from the holding of land were capitalized into land prices, the 13 percent rate of return on land-capital is a minimum estimate. There are three other reasons why we may have understated the slave-capital rate of return differential: we emplicitly assign capital's share of minor crop output to slaves; we perhaps should increase capital's rate of return to account for intertemporal growth in the stock of draft animals; the appreciation rate on slaves rather dubiously assumes that slave prices would have been the same in the absence of population growth.

natural rate of reproduction and to create capital gains and artifically high returns on investment for southern slaveowners.

REFERENCES

[1] Hugh G. J. Aitken, ed., *Did Slavery Pay?*, Boston: Houghton Mifflin Co., 1971.
[2] Arthur H. Cole, *Wholesale Commodity Prices in the United States, 1700-1861*, Cambridge: Harvard University Press, 1938.
[3] Alfred H. Conrad and John R. Meyer, *The Economics of Slavery*, Chicago: The Aldine Publishing Co., 1964.
[4] Charles E. Ferguson, "Substitution, Relative Shares, and Returns to Scale: Some Statistical Regularities and Curiosa," *Southern Economic Journal*, October 1967, 209-22.
[5] Robert W. Fogel and Stanley L. Engerman, eds., *The Reinterpretation of American Economic History*, New York: Harper and Row, 1971.
[6] ———. "The Relative Efficiency of Slavery: A Comparison of Northern and Southern Agriculture in 1860," *Explorations in Economic History*, Spring 1971, 353-67.
[7] ———. *Time on the Cross: The Economics of American Negro Slavery*, Boston: Little, Brown and Company, 1974.
[8] James D. Foust and Dale E. Swan, "Productivity of Antebellum Slave Labor: A Micro Approach," *Agricultural History*, January 1970, 39-62.
[9] Robert E. Gallman and Thomas J. Weiss, "The Service Industries in the Nineteenth Century," in *Production and Productivity in the Service Industries*, V. R. Fuchs, ed., Studies in Income and Wealth, N.B.E.R., 34, New York: Columbia University Press, 1969, 287-381.
[10] Eugene D. Genovese, *The Political Economy of Slavery*, New York: Pantheon Books, 1965.
[11] Lewis Cecil Gray, *History of Agriculture in the Southern United States to 1860*, Gloucester, Mass.: Peter Smith, 1958.
[12] Joseph K. Menn, *The Large Slaveowners of Louisiana*, New Orleans: Pelican Publishing Co., 1964.
[13] William N. Parker, ed., "The Structure of the Cotton Economy of the Antebellum South," *Agricultural History*, January 1970.
[14] ———. "The Slave Plantation in American Agriculture," *The First International Economic History Conference*, Stockholm, 1960, 321-31, Reprinted in *Essays in American Economic History*, A. W. Coats and R. M. Robertson, eds., London: Edward Arnold, Ltd., 1969.
[15] Ulrich B. Phillips, "The Economic Cost of Slaveholding in the Cotton Belt," *Political Science Quarterly*, June 1905, 257-75.
[16] ———. *Life and Labor in the Old South*, Boston: Little, Brown and Co., 1929.
[17] Charles W. Ramsdell, "The Natural Limits of Slavery Expansion," *The Mississippi Valley Historical Review*, September 1929, 151-71.
[18] Edward Saraydar, "A Note on the Profitability of Ante-Bellum Slavery," *Southern Economic Journal*, April 1964, 325-32.
[19] Richard Sutch, "The Profitability of Ante Bellum Slavery—Revisited," *Southern Economic Journal*, April 1965, 365-77.
[20] Marvin W. Towne and Wayne D. Rasmussen, "Farm Gross Product and Gross Investment in the Nineteenth Century," *Trends in the American Economy in the Nineteenth Century*, Studies in Income and Wealth, N.B.E.R., 24, Princeton: Princeton University Press, 1960, 255-315.
[21] U.S. Department of Agriculture, *Annual Report for 1873*.
[22] Richard Vedder and David Stockdale, "The Profitability of Slavery Revisited: A Different Approach," *Agricultural History*, April, 1975.
[23] A. A. Walters, "Production and Cost Functions: An Econometric Survey," *Econometrica*, January-April 1963, 1-66.
[24] Gavin Wright, "The Economics of Cotton in the Ante-Bellum South," unpublished doctoral dissertation, Yale University, 1969.
[25] Yasukichi Yasuba, "The Profitability and Viability of Plantation Slavery in the United States," *The Economic Studies Quarterly*, September 1961, 60-67.